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(54) Rapid gelling compositions

(57) A rapid or instantaneous gelling cementitious composition comprises 0-80% of a hydraulic cement, 15-80% of water, 0.01-5% of an organic gelling agent e.g. an acrylic polymer or copolymer and 0-85% of a fine bulk filler, e.g. flyash. The preferred compositions exhibit no slump but are thixotropic and may be pumped to a point of use, e.g. in an underground mine, where containment of a liquid grout would be difficult.

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SPECIFICATION

Rapid gelling compositions

This invention concerns rapid gelling compositions, and more especially it concerns rapid gelling hydraulic cement compositions and a method for their use.

It is known to use rapid setting and rapid hardening hydraulic cement compositions in underground mining, for a variety of uses including packing at the side of roadways, cavity filling, and the construction of seals, dams, stoppings and the like. We refer, as background, to our prior UK Patents GB 1576943 and 2058037B and to High Alumina Cement-based compositions illustrated by GB 2123808A. It is also known to utilise mixtures of fly ash, hydraulic cement, water and an inorganic flocculant in rapid setting compositions described in our UK Patent GB 2128179B.

We have now discovered hydraulic cement compositions which are rapid to instantaneous gelling, and which exhibit sufficient tolerance and flexibility in component quantities to provide a desirable range of properties from thixotropic characteristics to little or no slump. In general, these compositions do not exhibit rapid hardening, but they can offer particularly inexpensive compositions in addition to their desirable gelled properties.

According to the present invention, a rapid gelling hydraulic cement composition comprises, by weight, from 0 to 80% of a hydraulic cement, from 15 to 80% of water, from 0.01 to 5% of an organic gelling agent and from 0 to 85% of a fine bulk filler, the components of the composition together adding up to 100%. The invention further provides a method of producing a gelled hydraulic cement composition, comprising admixing components comprising a hydraulic cement in an amount by weight of 0 to 80%, a gelling agent in an amount of from 0.01 to 5% by weight, from 0 to 85% by weight of a fine bulk filler and water in an amount of from 15 to 80% by weight. The invention additionally provides a method of filling a void using a settable composition, wherein the settable composition is a gelled hydraulic cement composition according to the invention.

The invention may use a variety of hydraulic cements, of which the main types are Portland-type, Aluminous cements and cements based on calcium sulphate. Suitable Portland cements include Ordinary Portland Cement (O.P.C.), Rapid Hardening Portland Cement (RHPC), Portland Blastfurnace cement, Sulphate resisting Portland Cement, Extra Rapid Hardening Portland Cements and Portland cements containing a higher than usual alumina content. Aluminous cements suitably include High Alumina Cement according to British Standard 915 Part 2 and other aluminous cements containing Klein's compound. The calcium sulphate may include plaster of Paris and natural or synthetic anhydrites.

The bulk filler may be any fine material which improves, or does not significantly degrade, the setting, hardening and strength characteristics of the gelled cement composition and reduces its overall cost. Silica flour or limestone dust may be mentioned as examples. Colliery tailings may also be used. The filler may be a pozzolanic ash. The preferred filler is flyash, which is readily available at low cost. Mixtures of tailings and flyash may also be used.

Suitable organic gelling agents are those effective in the presence of hydraulic cement, that is effective in a normally neutral to alkaline environment. Preferred gelling agents are high molecular weight polymers, especially acrylic polymers and copolymers. A most preferred gelling agent is an acidic polyacrylate emulsion marketed by Allied Colloids Ltd under the trade name of Viscalex HV 30. The Viscalex HV 30 emulsion has an appreciable thickening effect on water when neutralised by the alkalinity of the hydraulic cement. In addition, it is believed that a further pronounced thickening effect arises from the flocculating effect of the high molecular weight polymer. A dry powder version of the emulsion is available under the trade name Viscalex HV100.

The gelling agent may be added at any point convenient to the particular method of operating the present invention. Thus, a powdered gelling agent may be pre-mixed with the dry hydraulic cement and/or a dry cement/filler mixture, giving a thixotropic grout when mixed with water, which will flow under pressure but reverts to a gel when pumping ceases. The gelling agent, optionally diluted with part of the water content of the final composition, may be pumped separately from a flowable hydraulic cement slurry or cement/filler slurry and injected into the pipeline conveying the cementitious slurry at or near the point of use. In some circumstances, it may be convenient to convey dry hydraulic cement or cement/filler mixtures pneumatically to a point of use where water is added and mixed therewith, and the gelling agent may be incorporated in the dry cement or mixture or may be added with or separately from the water.

The preferred method of use is to prepare a pumpable grout from mixing the cement and flyash with water. Conventional cement retarders such as lignosulphonates, hydroxycarboxylic acids, sugars and the like may be added without ultimate detriment to the gelling effect. Cement grout flow improving agents, or fluidifiers, such as melamine sulphonate/formalin condensate, sodium lignosulphonate etc. may also be incorporated, as may suspending agents such as bentonite and cellulose ethers. The resulting slurry can have a considerable workability time, thus enabling it to be pumped a long distance to a point of use. The preferred polyacrylate gelling agent is pumped along a separate pipeline to the point of use, where it is injected into the cementitious grout by means of a static mixer, resulting in instantaneous gelation. The highly thixotropic gelled material may then be sprayed into or onto the desired application site.

Conventional cement mixing and pumping equiment may be used.

The invention has particular application in underground mining, but is not limited thereto, and especially in the formation of bulk infills in

conditions where containment of a fluid grout would be difficult. As an example of an application, the gelled composition is used to fill splits formed by multi-entry longwall mining systems prior to the longwall starting production. Another example of application is in the infilling of headings made in bord and pillar techniques, the hardened composition forming new pillars and permitting the extraction of the previous pillars. The thixotropic composition may be pumped around concrete segmental lined roadways or tunnels to fill cavities between the concrete and the surrounding strata and to prevent point loading on the concrete segments. The composition may find general application for void and cavity filling underground or possibly in construction or civil engineering uses, where the fast development of compressive strength is not required.

Preferred ranges of the components are: hydraulic cement 3 to 10% by weight, water 20 to 70%, gelling agent 0.05 to 2% and bulk filler 25 to 75%. An exemplary composition comrises 61% of flyash, 6.1% OPC, 32.9% water, together forming a cement grout which instantaneously gells upon mixing with 0.2% of Viscalex HV30.

CLAIMS

1. A rapid gelling hydraulic cement composition comprising, by weight, from 0 to 80% of a hydraulic cement, from 15 to 80% of water, from 0.01 to 5% of an organic gelling agent and from 0 to 85% of a fine bulk filler, the components of the composition together adding up to 100%.

2. A composition according to claim 1, wherein the hydraulic cement is Ordinary Portland Cement.

3. A composition according to claim 1 or 2, wherein the organic gelling agent is an acrylic polymer or copolymer.

4. A composition according to claim 1, 2 or 3, wherein flyash is used as the fine bulk filler.

5. A composition according to claim 1, substantially as hereinbefore described.

6. A method of producing a gelled hydraulic cement composition comprising admixing components comprising a hydraulic cement in an amount by weight of 0 to 80%, a gelling agent in an amount of from 0.01 to 5%, from 0 to 85% by weight of a fine bulk filler and water in an amount of from 15 to 80%, all percentages being by weight and the components of the composition together adding up to 100%.

7. A method according to claim 6, wherein a dry powder premix comprising dry hydraulic cement, powered gelling agent and filler is admixed with water.

8. A method according to claim 6, wherein the gelling agent, optionally diluted with part of the water content of the final composition, is pumped separately from a flowable hydraulic cement slurry or cement/filler slurry and injected into the pipeline conveying the cementitious slurry at or near the point of use.

9. A method according to claim 8, wherein the injection of the gelling agent is effected by a static mixter.

10. A method according to claim 9, comprising spraying the resulting mixture into or onto a desired application site.

11. A method according to claim 6, substantially as hereinbefore described.

12. A method of filling a void using a settable composition, wherin the settable composition is a gelled hydraulic cement compositions according to any one of claims 1 to 5.

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